mighty. I have never known a great scientist to make that blunder. And there ought never to be one who makes it because the business of science is to see things as they are. Madame Curie has always remained simple, modest and unaffected in the face of the world's applause. That is the highest compliment which a fellow scientist can pay her, and the surest sign that she is not an ordinary person. With that I have paid my tribute of respect and honor and admiration to the discoverer.

Now for the discovery. How did it come about? What is it? What is its significance immediate? What is its significance remote and far-reaching? In order to answer that series of questions I wish to begin by disabusing your minds of the idea, if they harbor it, that a discovery in science is an isolated event. A science grows in the main as does a planet by the process of infinitesimal accretion. Practically every experiment in physics is a modification of an experiment which has gone before. Almost every new theory is built like a great mediæval cathedral, through the addition by many builders of many different elements, one adding a little here and another a little there so that to the eye of a distant observer in the clouds the whole structure seems to move forward in a practically continuous way. Even when you get close up and begin to see the discontinuities, for they are there, each experiment in the development of a given field of science is found to have a pedigree just as truly as has a race horse. Man-o'-war did not develop his marvelous speed in one generation. A dozen sires and dams contributed to that result. In precisely the same way, when in 1896 Henri Becquerel, professor of physics in the University of Paris, discovered the new, extraordinary property which certain types of matter were found to possess and which was named radio-activity, that discovery was sired by one made a year before by Roentgen, and Roentgen's was sired by Leonard's, and Leonard's by that of Hertz in 1886, and Hertz's by the work of Maxwell, and Maxwell's by that of Faraday in 1831, and Faraday's by that of Oersted in 1819, and Oersted's by Volta's, and Volta's by Franklin's, and so on without limit. And the point to which I wish to call your attention now is that it is of incalculable importance that there should be people like those who have given this gramme of radium to Madame Curie who have a vision that extends, not to this generation only, but to the generations that are to come a hundred, two hundred years ahead, and who consciously set about starting such a train of scientific discovery and progress.

But for our present purpose I wish to break into this chain of scientific development at the discovery by Professor Becquerel of this extraordinary phenomenon of radio-activity made in the physical laboratory in which Madame Curie had been studying for some years. The discovery itself was really a simple thing, as are practically all great discoveries. The year before Roentgen had found his X-rays, as he called them, which had the peculiar property of making it possible for one to see his own skeleton. That attracted the world's attention and Professor Becquerel was endeavoring to see whether rays that would penetrate in that fashion could be produced from other sources. He naturally took uranium, because of its fluorescent property, to see whether it, under the action of light, might perhaps transmute the light waves into penetrating waves of the kind Roentgen had obtained. What did he find? He tried it in the light and he tried it in the dark, and he found that it was not necessary to have light at all, but that a bit of uranium put away in a black paper on top of a photograph plate, itself would blacken the plate. In other words, there was a property of self-activity in that uranium. It emitted rays of some kind which would affect a photographic plate and discharge an electroscope. The discharge of an electroscope, in popular language, is simply this: When you comb your hair on a cold winter day and it stands out in all directions, it is because it becomes electrically charged. If now a bit of radioactive substance is held above your head, your hair will fall down again, *i.e.*, your electroscope will be discharged. The laboratory electroscope is merely a gold-leaf which stands out like your hair when it

of matter. With radium and with uranium we do not see anything but the decay. And yet somewhere, somehow, it is almost certain that these elements must be continually forming. They are probably being put together now somewhere in the laboratories of the stars. That is still something of a guess, it is true, and yet the spectra of the nebulæ show that they contain only the lighter elements. Can we ever learn to control the process? Why not? Only research can tell. What is it worth to try it? A million dollars? A hundred million? A billion? It would be worth that much if it failed, for you could count on more than that amount in by-products. And if it succeeded—a new world for man! But what have we got already through the discovery of radio-activity? An immensely stimulating new conception of the universe and of the way matter is behaving.

Next the significance of radium with respect to the question of the availability of energy. The amount of heat given off from one gram of radium in disintegrating into lead is 300,000 times as much as the amount of heat given off in the burning of one gram of coal. There is, then, in the radium a supply of sub-atomic energy, and this raises the question as to whether such energy exists locked up in other atoms and as to whether there is any possible way we can get at it? Do not be too sanguine about it as far as radium is concerned, because if all the radium at present in the world were set to work, although it is 300,000 times as potent as coal per gram in giving off energy, it would not suffice to keep the corner popcorn man's outfit going. It does not exist in sufficient quantity.

But what has its discovery done then in the field of energy? It has opened our eyes to the fact that certain kinds of matter certainly possess these stores of energy and it is almost a foregone conclusion that similar stores are also possessed by the atoms which we have not yet found to be changing—which are not radio-active. The astronomer has for years been completely puzzled to account for enormous amounts of energy which the sun and stars emit. He has not been able to find its source. It is impossible that the sun is simply a hot body cooling off, because we have evidence that it has lived longer than it could have lived if that were the case. The astronomer has now, however, seized upon the facts of radio-activity and surmises that these sub-atomic energies may be the source of the sun's radiation. If so the supplies are not so limited as we thought.

Look now at another side of this same problem. I am thinking particularly of the work of Professor Joly and Lord Rayleigh, who have made measurements of the amount of radio-activity of the ordinary surface rocks. Professor Joly has computed that if there are two parts of radio-active material for every million million parts of other matter throughout the whole volume of the earth, and this is considerably less than he has found on the average in the earth's crust, then this earth, instead of cooling off, is actually now heating up; so that in a hundred million years the temperature of its core will have risen through 1,800 degrees centigrade. That is a temperature which will melt almost all of our ordinary substances. What does it mean? It means that the life history of our planet is perhaps not at all what we have heretofore thought that it was. It means that a planet that seems to be dead, as this our earth seems to be, may, a few eons hence, be a luminous body, and that it may go through periods of expansion when it radiates enormously, and then of contraction when it becomes like our present earth, a body which is a heat insulator and holds in its interior the energy given off by radio-active processes, until another period of luminosity ensues. What I am now pointing out is the growth in our conception of the world, the growth in the thoughts of men that has come out from these studies. Do not think that this is not of importance. When Galileo discovered the moons of Jupiter he was doing just about as useless a thing from the standpoint of its immediate applicability to human relations as he could have found to do. And yet what did he actually accomplish? He started off the train of

rendered it possible to differentiate almost at a glance between a giant and a dwarf star. As a large amount of spectroscopic material was available at the Norman Lockyer Observatory for the application of Adams's method a trial research was begun. The method is based on a connection found by Adams to exist between the true brightness of a star and the intensity of certain lines in its spectrum. These line-intensities were determined by him by estimation, the plates being examined under a spectro-comparator. At the Norman Lockyer Observatory the method employed is to cover the lines gradually with a dark wedge, the position of which when a line is obliterated indicates the intensity of the line. The results of this trial research have proved very satisfactory, and were commented upon very favorably by Professor H. N. Russell on the occasion of a visit to the observatory. The above grant has been awarded to aid the extension of this research to all stars of suitable type down to declination —10° and of magnitude 6.5 and brighter. It is very opportune, for the staff of the observatory is small, and the work could not have been undertaken without such additional help.

HONORARY DEGREES CONFERRED BY YALE UNIVERSITY

At the commencement exercises on June 22 honorary degrees were conferred on several men of science. In presenting them Professor Phelps spoke as follows:

Master of Arts

Isaiah Bowman: formerly assistant professor of geography at Yale. Director of the American Geographical Society and editor of its *Bulletin*. He has led geological and geographical expeditions in South America. In 1917 he received the Gold Medal of the Geographical Society in Paris. He was the executive head of the house inquiry, being chosen for proved fitness. He did valuable work on boundaries for the Peace Commission in Paris. He is one more illustration of a college professor becoming so generally useful that the college is unable to keep him.

Doctors of Science

Hideyo Noguchi: distinguished Japanese scholar, M.D., Tokyo, 1897. He has made important discoveries in the treatment and prevention of smallpox and yellow fever. He is an honorary professor of three universities in South America; he has been given the Order of Merit by the Emperor of Japan. He is a striking fulfillment of the Scripture prophecy—"Seest thou a man diligent in business? He shall stand before kings." Dr. Noguchi has received the order of knighthood from three Kings—the Kings of Spain, Denmark and Sweden. Perhaps he appreciates even more than royal honors the admiration and gratitude of the people.

Madame Marie Curie: Marie Sklodowska was born in Warsaw and has always been a scientist; her father was a distinguished professor and her husband, Pierre Curie, will never be forgotten. She was educated at Warsaw and at Paris, and has been professor of radiology at Paris. It is superfluous to mention her discoveries in science, and now she has discovered America. She has often encountered dangers in scientific experiments, but nothing so dangerous as American hospitality; it is to be hoped she will not be a woman killed with kindness. She is unique. There is only one thing rarer than genius, and that is radium. She illustrates the combination of both.

Doctor of Laws

Sir Robert Jones: the leading British orthopædist. One of the many distinguished men contributed to the world by Wales. Lecturer on orthopædic surgery at the University of Liverpool; member of many learned societies, author of many books, recipient of many degrees to which number Yale is proud to add one more. Enormously useful during the war. He had charge of the orthopædic work of the British government 1914–1918. It is largely owing to him that England maintained during the war a position so characteristically upright.

James Rowland Angell: president-elect of Yale. Born in Vermont, a graduate of the University of Michigan. Professor and acting president of the University of Chicago. Exchange professor at the Sorbonne. At home anywhere and everywhere. Son of a great college president and ideally prepared to be one himself. Trained in scholarly research and in executive duties. A teacher of exceptional power. He has a thorough understanding of America's needs in higher edu-

the tree type of woody plant in the temperate zone.

B. W. Wells

North Carolina State College

THE AURORA OF MAY 14, 1921

To the Editor of Science: A very fine display of northern lights was observed here on Saturday night May 14th to daylight Sunday morning. It was first observed at 8:30 P.M. and was most conspicuous in extremely bright patches here and there in the sky, lasting usually not over a minute, with long arcs crossing the northern horizon. It was slightly cloudy, especially overhead and toward the northeast, but bright patches of aurora could be seen through the clouds. The sky was clear in the west and here and there groups of fine lines were visible, having always a slant of 60 degrees from the horizontal, corresponding to the dip of the compass at Tucson.

The colors were a dull white changing to a greenish tint in the northerly glows, a brilliant pearly luster in the patches and an occasional strong red color over large indefinite areas.

The display appeared to become somewhat less intense at 10:30 but shortly afterward showed renewed activity especially in long lines extending over large parts of the sky, which was now nearly clear, and all pointing toward a vanishing point of perspective situated about 30 degrees south of the zenith and a little to the west of the meridian, which is the direction of our lines of magnetic force extending toward the south pole. This vanishing point was very beautiful and was observed by many people. By one o'clock the display had somewhat diminished, but a later view at 3:30 showed a perfectly clear sky and the ordinary arcs crossing the northerly horizon with occasional nearly vertical streamers extending upward.

This was observed in many other parts of Arizona and far exceeds the recollection of anything of the sort seen here in forty years. I have notes upon four previous occurrences. One was seen from Flagstaff, Arizona, in the winter of 1894 and 1895. One was reported to me on November 5, 1916, and faint displays were seen here on October 9 and December 13, 1920. This was the first display of northern lights for most of the people of this part of the country.

A. E. Douglass

Steward Observatory,
The University of Arizona

THE AURORA SEEN FROM SINALOA, MEXICO IN LATITUDE 27° N.

The Northern Light display of May 14 was very plainly visible from the mesa here—only a few miles from the tropics. The Indians have been firing the forests to hasten the advent of the summer rains, and, when I first observed the glow along the sky-line formed by the Sierra Madre I thought they were indulging in their propitiation of the gods on a rather larger scale than usual. The glow began about eight o'clock and the rays were first visible about fifteen minutes later. They were white to pale yellow in color, ever changing in form, location, and brightness. Many of them appeared to reach an east-and-west great circle through the zenith, those low down in the eastern sky appearing longer. The apparent focus was several degrees east of north.

I had never before witnessed such a display and never expected that my first observation of the aurora would be from the semi-tropics.

J. Gary Lindley

QUOTATIONS

THE MOUNT EVEREST EXPEDITION

The organization of the expedition is now complete, and all the members proceeding from England have left for India. The leader of the mountain party, Mr. Harold Raeburn, sailed from Birkenhead direct for Calcutta on March 18. Colonel Howard Bury, chief of the expedition, left Marseilles for Bombay on April 9, and Mr. G. H. Leigh Mallory, one of the young climbers, sailed from London direct for Calcutta on the preceding day. Mr. A. F. R. Wollaston, surgeon and naturalist, left Marseilles for Bombay on April 16, and by the same boat Mr. G. H. Bullock, who had been selected at the last moment to replace Mr. George Finch, who was unfortunately, owing to ill-health, unable to take part in the ex-

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...soid, or ring, of matter wholly
... of a planet will give a direct
... the perihelion. But if the orbit
... in the matter composing such
...soid, then the effect is the opposite and
... motion of the perihelion will be retro-
grade. This, of course, upon the assumption that the density is uniform throughout; if the density is much greater in the central portions of the ellipsoid, then the retrograde effect of the outer portion may be overcome and the total effect upon the perihelion may be direct, but the motion will be less than that due to the central portion alone. By adjusting the rate at which the density is assumed to decrease, any motion of the perihelion, direct or retrograde, within limits can be obtained. To changes in the density of the envelope surrounding the sun may thus be attributed the discordant motions of the perihelia of the four inner planets, and especially the retrograde discrepancy in the motion of Venus.

The entire mass of matter, which is known to exist, may for the purposes of computation be considered as made up of three ellipsoids, or as showing two abrupt changes in density. The small central dense portion lies wholly within the orbit of Mercury, the intermediate portion wholly within the orbit of the earth,

fatalism—the sullen acceptance of a situation which is regarded as inevitable. What can a few dreamers do to stem the tide of such powerful biological and social forces as the prevailing spirit of commercialism, the concentration of present-day mankind in cities, with a resulting dominance of the urban viewpoint, and particularly the resistless pressure of increasing population everywhere?

Whether in the future these calamitous tendencies will be voluntarily checked by the intelligent concerted action of mankind, or whether they will be checked automatically by some world-wide catastrophe, need not concern us here. Ultimately some endurable balance will be struck between the human population of our globe and the available amount of food, space and other conditions essential to life. For all we know, this unbridled growth of population *may* be halted before the world is utterly congested, and while there are still large areas in a more or less primitive condition. Does not this last supposition contain enough of probability to warrant its acceptance as a guiding principle of action? Is it not worth while to reserve from settlement and exploitation extensive tracts of the earth's surface, representing at least the most interesting types of fauna and flora and physiography?

We have made a brave beginning in this direction, with our national and state parks, our national forests, national monuments, game refuges and the like, though it must be confessed that these reservations are still continually threatened by predaceous interests and that their permanence is not in the least assured.[1] But we should carry these efforts vastly further. The areas chosen should be more numerous and more diversified. A greater variety of motives should be given scope in achieving these ends. Economic considerations, such as the conservation of lumber and water-power, should still be recognized as immensely important, as should also the need for public recreation grounds. But purely scientific considerations should like-wise be accepted as legitimate reasons for reserving tracts from settlement or molesta-tion.

Work of fundamental importance regarding the phenomena of heredity has been done in our laboratories, experimental gardens and breeding-pens, and much of this work bears more or less directly upon the problems of organic evolution. But there are many of us who feel that these problems can not be solved without a very intensive study of the products of evolution in nature. To try to arrive at an explanation of the "origin of species" without an adequate analysis of the phenomena of geographic variation, and the inter-relationships of our species and subspecies in the wild, seems to some of us utterly bizarre.

So far, so good, but what can we do about it? This is naturally the hardest question of all to answer. To seek advice on this subject is my main excuse for writing this article. Let me say before going further that I do not make the absurd claim that I or my colleagues on this committee are solitary voices crying in the wilderness. Many and powerful are the influences already enlisted in support of one or another movement toward the protection of wild life and of natural scenery. And the concrete results, in terms of actual achievement, would require scores of pages even to outline. Many of these results have become incorporated into our laws and our machinery of government.

It is my purpose here to point out two fundamental needs: (1) the need of some one or more national organizations whose duty it shall be to coordinate all these activities and impulses, and (2) the need that our scientific men, and particularly our biologists, shall play a far greater part in this movement than they have ever done in the past. I shall speak of this second point first.

Biologists, above all others, should be in a position to appreciate the loss to science which results from the destruction either of single natural species or of natural associations of species. They are in a unique position to give advice as to what particular species and

[1] Witness the present federal water-power act (now happily amended), and the recent attempts to raid the Yellowstone.

ican biologists in the preservation of natural conditions. This society, with its special committee, would doubtless expect to continue actively in the field, even if the administrative and coordinating functions should be largely handed over to another body. The actual relations betwen the two must be left to the future to decide. It is entirely probable that an amicable and satisfactory solution will be reached when the problem presents itself.

In the meantime, this committee proposes to seek the support of various other organizations which may be interested in achieving the same ends. The present writer has undertaken to solicit the cooperation of some of our principal scientific societies, museums, universities and research institutions. Individual letters will doubtless be sent to the officers of many of these organizations in due time. Matters will be greatly expedited, however, if such officers will take the initiative into their own hands and will communicate with the committee as to what assistance they personally, or the organizations which they represent, are prepared to render.

The assistance might be of various sorts. (1) It might take the form of a mere endorsement or pledge of moral support to the Ecological Society's conservation activities. Such an endorsement, particularly if published in one of the scientific journals, would give to these activities a certain degree of publicity, as well as an added importance in the eyes of many persons. Some recent resolutions of the American Association for the Advancement of Science, the American Society of Zoologists and the Botanical Society of America are cases in point.[2] Unfortunately, however, most of our national scientific societies have thus far shown no interest in the conservation of nature. The officers of one leading biological society decided a year ago that the subject was not germane to the purposes of their organization, and a resolution which had been drafted by one of its members was not even brought to a vote.

(2) Some of these societies might well be expected to go much further than voting a mere cut-and-dried endorsement of conservation activities. Why should not occasiona papers, lectures or even symposia in this fiel be regarded as appropriate material for thei programs? Many of the data which are mad use of in the campaign for the preservation o natural conditions are likewise of high scientific interest. Various results of disturbin the balance of nature might be mentioned i this connection.

(3) Advice would be welcomed as to line of activity which the committee might profitably undertake. Suggestions as to possibl methods of "organizing" the various scientific interests are to be included here.

(4) Financial assistance is needed, even fo this committee's present limited activities The suggestion has been made that some o the scientific societies might be willing t contribute a certain fraction of their annua dues to the Ecological Society for the purpos of supporting its conservation activities. A appeal has already been made to the Nationa Research Council for a grant for this purpose

As an aid in the promotion of these end it has been proposed that the various scientific and research organizations so dispose should form some sort of a loose federation o association of "societies interested in th preservation of natural conditions." Thi would be likely to promote the interchange o ideas, and effectiveness of action, where actio seemed called for. The constituent societie would presumably appoint delegates to th meetings of this federation; these delegates being such of their members as have shown th most active interest in conservation matter Such a federation would naturally have som organic relation to the Ecological Society' committee. Its efforts, at present, might b effective in several directions: publicity an education, endorsement of or opposition t proposed legislation, actual investigations o specific cases in which emergency measure seem to be necessary, and perhaps some others

The writer would welcome opinions fro the officers of these societies as to the desirability of forming such a federation. H would also greatly appreciate any suggestion

[2] SCIENCE, January 7 and January 28, 1921.

situated, a practical evidence that the people closest to the park are alive to the importance of our government owning the land.

The contributors and the amounts contributed were:

Research Fund of the National Geographic Society	$ 5,000
W. F. Chandler, Fresno, California	6,000
George F. Eastman, Rochester, New York	15,000
William Kent, Kentfield, California	250
Stephen T. Mather, Director National Park Service	14,000
Charles W. Merrill, Berkeley, California	250
James K. Moffit, San Francisco	500
John Barton Payne, former Secretary of Interior	2,000
Julius Rosenwald, Chicago, Illinois	1,000
Rudolph Spreckels, San Francisco	1,000
Special Tax Levy of Tulare County, California	10,000
	$55,000

Thus the National Geographic Society has conveyed to the United States government a total acreage in Sequoia National Park of 1,916 acres, purchased at a total cost of $96,330.

It should be noted that the gifts were not solicited by the society. The National Geographic Society asks its membership for no contributions of any sort. Its publications and its scientific and educational activities are entirely supported by their dues.

Every member of the society may feel that he had a part in this enduring gift to his country and to posterity, for the funds appropriated directly by the society for the purchase of the Sequoias came from the fraction of the dues of members set aside for such benefactions.

The tender was made in the name of the National Geographic Society because, as the director of the National Park Service, Mr. Mather, put it:

It is only proper that this gift should come to the government through the National Geographic Society, in view of the keen interest which the society has taken in the purchase of the other private holdings in this park. It was through direct gifts by your society that we were able to save the Giant Forest, which contains the finest stand of *Sequoia Washingtoniana* in the Sierra.

Following the presentation, Albert B. Fall, Secretary of the Interior, wrote to Gilbert Grosvenor, president of the National Geographic Society:

Dear Mr. Grosvenor: It was a very pleasant surprise when you called on me on April 20 and, on behalf of the National Geographic Society, presented the title deeds and other pertinent papers conveying to the United States the so-called Martin tract of 640 acres in the Sequoia National Park, recently purchased at a cost of $55,000 by your Society, through the generosity of its members, in order that this area with its fine stand of trees might be preserved for the American people.

I have already personally expressed to you my sincere thanks and my acceptance of the proffered gift. Your society on several preceding occasions has stepped in at a critical moment and acquired several similar areas in this same park, thereby saving from extermination other wonderful trees that would otherwise have fallen under the axe.

Your society is to be highly commended on its substantial expression of a high public spirit, and on behalf of the United States I again want to express to you, and through you to the contributors, my deepest appreciation of your generous and considerate action.

Respectfully,

ALBERT B. FALL

Mr. Gilbert Grosvenor,
President, National Geographic Society,
Washington, D. C.

To mankind, throughout the ages, trees have been the most human-like, the most companionable, of all inanimate things. Aristotle thought they must have perceptions and passions. An infinitely more scientific generation still is sensible to their mystical power.

More and more will Americans visit Sequoia National Park to gaze upon the majesty of "Nature's forest masterpieces" in their last stand. National Geographic Society members may well be proud that they had a part in preserving for all time these mementos of a past far beyond the records of written history.

the preliminary announcement of the executive committee as follows:

The Research Board of the University of California is arranging a research conference to be held at the luncheon hour on Thursday, August 4. The special topic for discussion will be "A Survey of Research Conditions in Pacific Coast Institutions." The meeting will be open to members of the Pacific Division and of affiliated societies who are particularly interested in the development of research in Pacific coast colleges and universities.

THURSDAY, AUGUST 4, 2:00 P.M., IN WHEELER HALL

Science and the Public Health

Following the plan so successfully introduced at the Pasadena meeting in 1919, and successfully continued at the Seattle meeting in 1920, of attempting some constructive application of scientific knowledge to important problems of the day, there has been arranged for this meeting a symposium on the afternoon of August 4. The subject is that of the relation of science to public health—a subject with which every one is vitally concerned. An analysis of the vote on each of the four so-called "health amendments" upon which the electorate of California was permitted to express its views at the general election last November, is all that is required to enable one to realize the seriousness of the situation and the necessity for a campaign of education. The public should be fully informed as to what the adoption of those amendments would really mean. To assist the public to a realization of the seriousness of this menace to scientific investigation and to the public health, a symposium has been arranged in which the question will be presented from different viewpoints, as follows:

Public health and human welfare: DR. RAY LYMAN WILBUR, president, Leland Stanford Jr. University.

Whose business is the public health? DR. F. P. GAY, professor of pathology, University of California.

Education in relation to public health and medical practise: DR. S. J. HOLMES, professor of zoology, University of California.

Physical health and mental health: DR. PHILIP KING BROWN, president of the California Tuberculosis Association, San Francisco.

Rural and Industrial Sanitation: DR. C. A. KOFOID, professor of zoology at the University of California.

Public health and experimental biology: DR. H. B. TORREY, professor of zoology, University of Oregon.

Immediately following the close of the symposium, a general session of the Pacific Division will be held for the purpose of electing four members of the executive committee.

THURSDAY, AUGUST 4, 8:00 P.M., IN WHEELER HALL

On the evening of August 4, President David P. Barrows, of the University of California, will give an address of welcome to which response will be made by Dr. Barton Warren Evermann, chairman of the executive committee. This will be followed by the address of the retiring president of the Pacific Division, Dr. William E. Ritter, who will speak on "Scientific Idealism." After the address of the president a reception will be held. The public is cordially invited to attend this and all meetings and lectures of the Pacific Division and of the affiliated societies.

A public address will be given on the afternoon of August 5 by Professor Henry Norris Russell, professor of astronomy, Princeton University, on "The properties of matter as illustrated by the stars."

A banquet will be arranged for the evening of August 5 for all members of the Pacific Division and affiliated societies. The cost per plate will not exceed $2.00.

Astronomical Society of the Pacific

CHARLES S. CUSHING, president, First National Bank Building, San Francisco.

D. S. RICHARDSON, secretary-treasurer, 22 Battery St., San Francisco.

Meetings of the Astronomical Society of the Pacific will be held in Room 1, Students' Observatory, University of California, Berkeley,

Pacific Slope Branch, American Association of Economic Entomologists

E. O. Essig, chairman, University of California, Berkeley, Calif.

A. L. Lovett, secretary-treasurer, Oregon Agricultural College, Corvallis, Oregon.

There will be scientific programs on August 4 and 5 and excursions on August 6 and 7. An entomological dinner has been arranged for August 4.

San Francisco Society, Archeological Institute of America

David P. Barrows, president, University of California.

H. R. Fairclough, secretary, Stanford University.

A meeting of the San Francisco Society, Archeological Institute of America, will be held Thursday morning, August 4, at which papers will be read by members and others interested.

Seismological Society of America

Otto Klotz, president, Dominion Astronomical Observatory, Ottawa, Canada.

S. D. Townley, secretary-treasurer, Stanford University, California.

A meeting of the Seismological Society of America will be held, the details of which will be given in the final program.

Southern California Section, American Chemical Society

Stuart J. Bates, president, California Institute of Technology.

H. L. Payne, secretary, 223 West First St., Los Angeles, Calif.

The Southern California Section of the American Chemical Society will join with the other sections of the American Chemical Society in a meeting to be held on Friday morning, August 5.

Western Society of Naturalists

J. Frank Daniel, president, University of California.

Chester Stock, secretary-treasurer, University of California.

The Western Society of Naturalists will meet at the University of California in conjunction with the meetings of the Pacific Division. Sessions for presentation of miscellaneous scientific papers on biology will be held on the mornings of August 4 and 5 and at other times during the progress of the general meetings should there be additional papers to be presented.

SCIENTIFIC EVENTS

JOHN HARPER LONG

The many friends of the late Professor John Harper Long, for thirty-seven years professor of chemistry in Northwestern University, will appreciate the portrayal of the man as a teacher, investigator, public servant and friend, contained in the small volume entitled "John Harper Long,—A Tribute from his Colleagues." It is edited by Dr. Robert H. Gault of Northwestern University, contains a chapter by F. B. Dains, entitled "Student, Teacher and Chemist," one by F. Robert Zeit "A Colleague at the Medical School," another by Ira Remsen on "Dr. Long as a Member of the Referee Board," and an appreciation of the last ten years of Dr. Long's scientific work by Julius Stieglitz and Paul Nicholas Leech. Dr. Frank Wright reviews Dr. Long's activities in connection with Chicago's gigantic drainage problems and the volume concludes with a comprehensive bibliography of Dr. Long's publications, comprising one hundred and eighteen contributions.

There is thus compassed in seventy pages, tastily arranged, a fitting tribute to a man who did so much for chemistry and education. One outstanding feature of Dr. Long's professional life comes back vividly to the reviewer, a characteristic which indexed well his deep, unselfish interest in his profession, namely, his constant attendance and active helpful participation in the national and sectional meetings of the American Chemical Society. Even long after his health should have demanded more consideration of self he gave unstintingly of his time, his counsel and his uplifting ideals, to the organization which had given him its highest honor.

The edition is limited to a thousand and copies may be obtained through Professor

cepted a position as pathologist at the Babies Hospital, New York City.

Dr. Israel J. Kligler, hitherto an associate in bacteriology, has accepted an appointment with the Zionist Medical Unit in Palestine.

SCIENTIFIC NOTES AND NEWS

DR. F. H. KNOWLTON, of the U. S. Geological Survey, received the honorary degree of doctor of science from Middlebury College, at its recent commencement.

PROFESSOR LAWRENCE J. HENDERSON, of Harvard University, has been elected a foreign correspondent of the Paris Academy of Medicine.

DR. H. S. WASHINGTON, of the Geophysical Laboratory, Carnegie Institution of Washington, has been elected a foreign honorary member of the Norwegian Academy of Sciences.

PROFESSOR FLORIAN CAJORI, of the University of California, has been elected fellow of the American Academy of Arts and Sciences.

DR. A. SMITH WOODWARD, keeper of geology in the British Museum of Natural History, has been elected president of the Linnean Society of London.

DR. GEORGE M. PIERSOL, who has been professor of anatomy in the University of Pennsylvania for thirty years, is retiring from active service.

DR. MICHAEL E. GARDNER has been appointed chief of the bureau of preventable diseases and director of the bacteriologic laboratory of the United States Public Health Service.

THE Albert medal of the Royal Society of Arts for 1921 has been awarded to Professor J. A. Fleming in recognition of his contributions to electrical science and its applications.

CHARLES F. RAND, chairman of the executive board of Engineering Foundation, has been elected an honorary member of the Iron and Steel Institute of Great Britain. Mr. Rand is honorary secretary of the John Fritz Medal Board of Award in London which recently bestowed the John Fritz Medal for achievement in applied science on Sir Robert Hadfield. On July 8 the mission went to Paris to confer the John Fritz Medal for 1922 upon Eugene Schneider, head of the Creusot Works.

GEORGE OTIS SMITH, director of the United States Geological Survey, sailed for England on July 9 on the *Cedric* to attend the meeting of the organization committee of the International Geological Congress in London on July 20. Professor R. W. Brock, of the University of British Columbia, the chairman of this international committee, is the other representative of the Western Hemisphere. The last meeting of this congress was held in Canada in 1913, when Belgium invited the congress to meet in Brussels in 1916. This invitation has been renewed for 1922.

DR. WILLIAM H. WELCH, director of the school of hygiene and public health, Johns Hopkins University, is among those who will attend the dedication of the new buildings of the Peking Union Medical College, at Peking, China, in September.

PROFESSOR THOMAS HUNT MORGAN, of Columbia University, is spending the last few months of his sabbatical leave at the University of California, where he and his group of assistants are continuing their genetic investigations of *Drosophila*. The other members of the party are Dr. A. H. Sturtevant, Dr. C. B. Bridges, Dr. D. E. Lancefield, Mrs. D. E. Lancefield and Miss Phoebe Reed, cytologists, and Miss Edith Wallace, artist. The party will remain at the university until the opening of Columbia University about Sept. 15.

THOMAS FORSYTH HUNT, dean of the college of agriculture at the University of California, has returned to the university after a year's travel and study in Italy, Sicily, Egypt, England and Scotland. The main purpose of his trip was to make a survey of European methods of agriculture with special reference to fruit production and its effect upon the progressive development of various nations.

DR. O. G. F. LUHN, of Larawok, Borneo, recently arrived at the University of California

cial interest, the first working aneroid made by Vidi in 1857, and a series of models illustrating the development of the chick.

BARON EDMOND DE ROTHSCHILD, administrator of the Eastern Railway Company of France, has given 10,000,000 francs to found a scientific institute to encourage students to devote their lives to the work of research. The institute will aim to develop science in industry and agriculture. The institute is to be managed by a council, members of which are to be elected by the Academy of Sciences, the College of France, the Faculty of Sciences and the Paris Museum.

THE *Journal* of the American Medical Association reports that a new pathological and bacteriological institute has been opened in Prague. There are divisions for pathologic anatomy, experimental pathology, bacteriology and legal medicine. It is popularly called Hlava's Institute, from the name of its chief, Professor Jeroslav Hlava. Dr. Hlava is the senior professor of the staff of the Czech medical school, and is a well known authority on exanthematic fevers. In addition to being president of several medical societies and a corresponding member of the French Academy of Medicine, he is also the president of the Czech Society for Cancer Research. On the day the new building for pathology was opened, the president of the republic made a gift of 100,000 crowns to the Cancer Society for continuing and developing its work.

THE importance of regular meteorological reports from Greenland for the forecasting services of Western Europe, and, indeed, for that of Canada also, has, says *Nature*, been recognized for some years. The question of these reports was discussed at the meeting of the International Commission for Weather Telegraphy which was held in London in November last, and the commission decided unanimously that "the establishment at the earliest possible date of a high-power radio-telegraphic station in Greenland is of the utmost importance to the meteorology of Western Europe, and, further, it is of such importance as to warrant the international provision of funds for maintaining it." It is probable that the provisi of such a station by the Danish governme will be made at an early date. When t station has been provided it will be possible make a definite use in weather forecasting Europe of meteorological observations fr Canada and the United States. Hitherto t gap between the European and American o servations has been so great that meteorologi have been unable to justify the expense whi would be involved in regular cable messag from America to England.

THE medical division of Stanford Universi Medical School has received a grant of $3 from the Committee on Scientific Research the American Medical Association. Th money is to be used for the furtherance of a investigation into the factors influencing t rate of urea excretion.

UNIVERSITY AND EDUCATIONAL NEWS

BEQUESTS amounting to $16,624,203 are a sured to the medical schools of Harvard, C lumbia and Johns Hopkins Universities by t action of Miss Alice A. De Lamar in t Surrogate's Court in waiving her rights to pr test the will of her father, Captain Joseph De Lamar. The will left more than half of h estate, valued at $33,327,000, to education an charity. The descendant's estate law of Ne York bars a person from leaving more tha half of his estate to charity, without appprov of the heirs.

DR. G. CANBY ROBINSON, Baltimore, has a cepted the post of professor of medicine at t Johns Hopkins Medical School and physicia in-chief of the Johns Hopkins Hospital, succeed Dr. William S. Thayer. Dr. Robi son is now professor of medicine and dean the medical faculty of Vanderbilt Universit Nashville, Tenn., and expects to return at t end of the year.

DR. PAUL J. HANZLIK, associate profe sor of pharmacology, school of medicin Western Reserve University, has been a pointed professor of pharmacology in t

consciousness, or surround himself with the artificial atmosphere of erudition. . . . In England the isolation from society and the solitariness of genius threw him into the arms of Nature. . . .

Again on page 276:

But it is a fact that no Academy existed in this country which was zealous in collecting and arranging all the best labours of scattered philosophers, no university which was anxious to attract and train promising intellects. . . .

Most of the phrases in Professor Carmichael's paragraph on British science and also in the paragraph contrasting the temperaments of the three European nations will be found in this chapter of Merz's on pages 250, 252, 279, 281 and 300.

I wish to point out that what Merz wrote in 1896 about English science and English universities in the first half of the nineteenth century does not necessarily apply to British science and British universities at the present time. As Merz remarks on page 300:

During the second half of the century a process of equalisation has gone on which has taken away something of the characteristic peculiarities of earlier times. The great problems of science and life are now everywhere attacked by similar methods. Scientific teaching proceeeds on similar lines, and ideas and discoveries are cosmopolitan property.

Whether or not this is a fact, and whether or not, if it is a fact, the final paragraphs of Professor Carmichael's paper are sound, I do not pretend to judge. But I do protest that the statement that the British have no university eager to nurse and develop new talent is not true to-day, even if it was true in 1850.

It may also be proper to note that Merz's statement definitely applies to *English* rather than to *British* universities; and on page 271 the Scottish universities of that day are contrasted with their English sisters.

J. W. Clawson

To the Editor of Science: The criticisms of my article on "National temperament in scientific investigations," offered by Mr. J. W. Clawson, are essentially the following two It is implied that I have made an imprope use of Merz's "European Thought"; it i claimed that I have been unjust to the Britis in a certain particular. I appreciate the op portunity to say a word about them.

With respect to the first of these I prefe to leave it to the reader, who makes the com parison between the two paragraphs named b Mr. Clawson and the passages in Merz referre to by him, to determine whether my practis is justifiable, calling his attention to the fac that the statements in one of these paragraph were given as what seemed to me to be "th impartial verdict of history" rather than a an expression of judgment independentl formed by me.

With regard to the question of injustice t the British I have the following to say: Th main burden of my paper was to urge upo my own countrymen the desirability of re alizing in their own scientific activity the char acteristics of spontaneity and individualit which have particularly marked the work o the British and which have led (as it wa pointed out) to a greater fruitage of th larger things among them than has fallen t the lot of any other people; in the particula (and somewhat unfortunate) phrase criticize I had no intention to say anything particu larly harmful to the British nor had I sup posed that I had done so; one of my corre spondents has expressed his pleasure in wha he was pleased to call my just emphasis of th value and importance of the British method and results; Mr. Clawson now appears to thin that I am quite unjust to the British (at leas in a certain particular); another has alread belabored me for being unjust to the Ger mans; if still another shall accuse me of like injustice to the French, I shall begin t think that I have held a fair balance amon the three nations in my attempt to point ou certain values realized by them which I wis to see attained by the scientists of Americ in fuller measure in the future than in th past.

R. D. Carmichael

University of Illinois

SPECIAL ARTICLES

THE PREDICTION OF THE PHYSIOLOGICAL ACTION OF ALCOHOLS[1]

COMPARATIVELY few laws are known connecting the chemistry of various substances with their physiological effects; such a condition is natural because of the complexity of many of the compounds used in therapeutics. In seeking for generalizations it is therefore advisable to direct our attention at first to compounds possessing rather simple structures.

In connection with the testing of the toxicity of various normal primary alcohols upon *Paramecia* the writer noticed the almost quantitative application of a simple numerical rule. Methyl alcohol, as was expected from its structure, exhibited an abnormaiity, but beginning with ethyl alcohol and expressing its action as *unity* the acute toxicities of the successive members subjected themselves to numerical expression, particularly when the quantity of alcohol used was expressed in moles and not in grams.

In an homologous series of this kind the molar toxicity of any given member is three times that of the preceding member. The rule is expressed numerically by the geometrical progression:

$$1 : 3 : 3^2 : 3^3 : 3^4 : 3^5 \ldots.$$

The value of this generalization, originally presented by Traube on the basis of surface tension experiments, lies in the fact that it may be appplied not merely to unicellular organisms, but to mammals as well. Its application is shown best by a few examples.

EXAMPLE I

The toxic concentration of ethyl alcohol for a given strain of paramecia was found by experiment to be 4.5 per cent. What concentration of *n*-octyl alcohol will prove equally toxic to the same strain of organisms?

Solution: $1 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729$.

$$\frac{4.5\% \times 2.8^{*}\,[2]}{729} = 0.02\% = \text{calculated concentration.}$$

The observed value was found to be 0.03 per cent.

[1] Article No. 4, Chemical Research Department, Parke, Davis & Co.

EXAMPLE II

If a mouse is killed within a few hours by intraperitoneal administration of 12 mg. of ethyl alcohol per gram of body weight, what will be the corresponding toxic dose of *n*-amyl alcohol?

Solution: $1 \times 3 \times 3 \times 3 = 27$.

$$\frac{12 \text{ mg.} \times 1.9^{*}}{27} = 0.84 \text{ mg.}$$

The observed value was found to be very close to 1.0 mg. per gram of body weight.

EXAMPLE III

The toxic dose of ethyl alcohol when injected into the blood stream of the cat was found by Macht[3] to be 5.0 c.c. per kilo. The administration time was 50 minutes. Under exactly similar experimental conditions what will be the toxic dose (*a*) of *n*-propyl alcohol, (*b*) of *n*-amyl alcohol?

Solution: (*a*) $1 \times 3 = 3$.

$$\frac{5.0 \text{ c.c.} \times 1.3^{*}}{3} = 2.17 \text{ c.c.}$$
$$= 2.14 \text{ c.c. corrected for sp. gr.}$$

The experimental value was found by Macht to be 2.0 c.c., although in this case the toxic amount of liquid was administered during 20 minutes.

Solution: (*b*) $1 \times 3 \times 3 \times 3 = 27$.

$$\frac{5.0 \times 1.9^{*}}{27} = 0.35 \text{ c.c. (uncorrected for sp. gr.).}$$

The experimental value was found to be 0.15 c.c., which is a very satisfactory result in view of the fact that the toxic material was administered during seven minutes. When administered over an interval of from 30 to 50 minutes the observed value would no doubt approach the calculated value.

A more detailed discussion of the present work is appearing in a series of reports in the *J. Am. Pharm. Association.*

OLIVER KAMM

[2] The values marked with the asterisk are molecular weight ratios which serve to convert the predicted values from moles to grams.

[3] *J. Pharmacol.*, 16, 1 (1920).

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF ORGANIC CHEMISTRY

(*Continued*)

Symmetrical tribromphenylpropiolic acid and its reaction with acetic anhydride: ROBERT CHAMBERS. Phenylpropiolic acid condenses with acetic anhydride to form a phenylnaphthalene dicarboxylic anhydride. This reaction holds for derivatives of phenylpropiolic acid where there is a free ortho hydrogen. It was desired to investigate the action of acetic anhydride on a di ortho substituted phenyl propiolic acid. The above acid was prepared from meta nitro cinnamic acid as follows: reduction with zinc and hydrochloric acid gave meta amido hydrocinnamic acid. Bromination and subsequent diazotization in boiling ethyl alcohol gave 2.4.6 tribromhydrocinnamic acid. Heating to 145° in a sealed tube with bromine gave $\alpha\alpha$ dibrom 2.4.6 tribromhydrocinnamic acid. The latter with hot alcoholic potash gave 2.4.6 tribromphenylpropiolic acid. With acetic anhydride the above acid does not condense to a phenylnaphthalene derivatives but forms an anhydride which may be hydrolyzed to the original acid.

The reactions of alpha anthroquinonesulfonic acids with mercaptans: E. EMMET REID, COLIN M. MACKALL and G. E. MILLER. Sodium anthroquinone-alpha-monosulfonate and the 1.5 or 1.8 disulfonates react readily with mercaptans in water solution to replace the sulfonic acid group by —SR to give anthraquinone alkyl thio-ethers or dithio-ethers, α-$C_{14}H_7O_2.SR$, 1, 5-$C_{14}H_6O_2(SR)_2$ and 1.8-$C_{14}H_6O_2(SR)_2$. The disulfonates may give the intermediate alkyl thio-ether sulfonate.

The polymers of pinene: G. B. and C. J. FRANKFORTER and E. R. KRYGER.

Contribution to our knowledge of the chemistry of calcium carbide: G. B. FRANKFORTER and A. E. STOPPEL.

A new lactone from oil of orange: FRANCIS D. DODGE. Essential oils of citrus species, obtained by expression, on standing generally deposit solids from which certain lactones derived from coumarin have been obtained. In the present communication is described a new lactone of rather unusual properties obtained from the sediment of West Indian oil of orange. It forms colorless needles (m. p. 88–90°) easily soluble in alcohol and ether, slightly so in ligroin. Optical rotation is about —38° in alcohol. On acidifying an alkaline solution it yields a crystalline acid (m. p. 151°) from which no crystalline salts could be obtained. It yields no acetyl derivative, and cannot be reconverted into the lactone. It is readily oxidized by permanganate. The lactone, like coumarin, yields a crystalline compound with bisulfite. Analysis indicates the empirical formula $C_{16}H_{18}O_3$.

The bromination of 2-amino-p-cymene: ALVIN S. WHEELER and IRA W. SMITHEY. Pure p-cymene obtained from spruce turpentine, was nitrated and the 2-nitro-p-cymene was reduced with Sn and HCl. The acetyl derivative of 2-amino-p-cymene in CCl_4 solution was boiled with bromine. Bromo derivative, needles, m. 122°; yield 60 per cent. Hydrolysis gave free amine, liquid, b. 169°–170° at 20 mm., d_4^{20} 1.3012, n_D^{20} 1.5781. HCl salt, plates, m. 206°–210°. HBr salt, plates, m. 205°. Diazobromoaminocymene, canary yellow needles, m. 146°–148° (decomp.). Oxidation of bromoacetylaminocymene with neutral permanganate gave a toluic acid derivative, m. 213°. Hydrolysis with acid gave the bromoamino acid, needles, m. 151°; HCl salt, plates, m. 190° (decomp.). No bromoamino toluic acid of this description could be found in the literature. The Br atom appears to be in the 3 position.

New derivatives of 2, 3, 8-tribromo-5-hydroxy-1, 4-naphthoquinone: ALVIN S. WHEELER and T. M. ANDREWS. Action of NaOH on the tribromoquinone (*A*) gave the 2, 3-dibromo-5, 8-dihydroxy-1, 4-naphthoquinone (*B*), which, reduced with Zn and H_2SO_4, gave 2, 3-dibromo-1, 4, 5, 8-tetrahydroxynaphthalene, greenish needles, m. 164°–166°. Tetracetyl derivative, yellow needles, m. 149°–150°. Acetyl derivative of *B*, yellow prisms, m. 197°. Methyl ether of *A*, yellowish red plates, m. 209°–210°. Ethyl ether of *A*, yellow needles, m. 134°–136°. Aniline derivative of *A* (Br No. 8 replaced), purplish chip-like crystals, m. 235°. *A* is converted by Zn and H_2SO_4 into the trihydroxy derivative, yellowish needles, m. 106°–107°; triacetyl derivative, colorless prisms, m. 220°. Br. No. 8 in *A* is replaced by Cl with HCl and alcohol, golden bronze plates, m. 152°; acetyl derivative, yellow prisms, m. 160°. Ketone reagents on *A* do not give well defined products.

The bromination of 2-amino-p-cymene: ALVIN S. WHEELER and I. W. SMITHEY. (By title.)

The production of furfural by the action of superheated water on aqueous corn cob extract: F. B. LAFORGE. (By title.)

error to judge the egg content by the value obtained in the aforesaid determination.

Peanut by-products: J. B. Reed.

Some factors governing the crystallization of lactose in ice cream: Harper F. Zoller and Owen E. Williams. A curve is presented as a result of experimental evidence which serves to separate those mixes which will produce sandiness from those which will not, and is based upon the relationship existing between the protein-serum solids concentration and the concentration of lactose within the mix. It is erroneous to calculate the concentration of lactose on the water basis since the total water in the mix is not available to the lactose because of the competition of the other solids. The effect of the proteins within the mix is not to repress the crystallization of lactose, but they act oppositely in increasing concentration. Because of its slow rate of crystallization lactose hydrate is subject to much supercooling and oversaturation. Protein has very little effect upon its rate of growth. The solubility of lactose hydrate according to the best of experimental deductions is 11.15 per cent. at 0° C. In an ice cream mix containing 10 per cent. fat, 14 per cent. of cane sugar and 65 per cent. of water, the above value for lactose reduces to about 8.9 per cent. calculated on the water basis.

A rotating thermocouple and cold junction designed for temperature studies in horizontal power ice cream machines: Harper F. Zoller. A sensitive and experimental thermocouple is described and illustrated which has been designed for the purpose of accurately measuring the temperature of the ice cream mix within the freezer when the latter is rotating at full speed. By maintaining an ice-water cold junction affixed to the shaft of the freezer along with the thermocouple junctions the small temperature differences within the freezer can be measured with an accuracy of .02° C. This latter is also made possible by the use of a five junction copper-constantan thermocouple (of fine wire for small temperature lag effect) and a potentiometric setup embracing a galvanometer of low internal resistance with a potentiometer of microvolt capacity. The unique feature of the instrument is the method of conducting the small e.m.f. from the rapidly rotating shaft to the potentiometer without frictional thermoelectric effects. The instrument has been in regular service for a number of months, has given no trouble, and has measured the rapidly fluctuating temperatures within the mix simply and accurately.

Cases of supercooling during the freezing of ice cream mixes: Harper F. Zoller and Owen E. Williams. By the use of the rotating thermocouple we have examined the point of separation of ice in a variety of mixes. The measurements were made in a commercial ice cream machine of the Miller type with a capacity of five gallons. The freezing point lowering of the mix was not in harmony with the calculated value, but showed a high supercooling in the mix even in the presence of the swiftly moving beaters and scrapers. The addition of fine particles of substances to promote the formation of crystal nuclei prevented the supercooling of the mix and consequently the freezing was done in a shorter time, and the product was smoother. Both fat and gelatin seem to reduce supercooling in the average mixes. When sand is added to an ice cream mix containing 10 per cent. fat and 0.5 per cent. of gelatin ice begins to separate at only a slightly higher temperature when the brine is at 10° F. during the freezing process. If the brine is much lower there is a greater difference in the supercooling effect when no sand is present in the above mix. When mixes are frozen which have been made from evaporated milk containing lactose crystal nuclei and they have not been destroyed by pasteurization, or other means, no supercooling occurs. A great deal of importance is attached to the degree of supercooling and its influence upon the texture of the ice cream as it comes from the freezer.

Black discoloration in canned sweet potatoes: Edw. F. Kohman. The black discoloration which occurs in canned sweet potatoes begins in the bottom of the can where there is usually a semiliquid starch paste which affords close contact with the can. Eventually it may penetrate the entire content of the can. The black formation is due to the combination of iron dissolved from the can with a tannin-like substance in the potatoes. This is localized to a considerable extent just beneath the peel. But as there is also some throughout the potato and especially about the center no change in present methods of peeling would be of advantage. Tannins do not form black compounds with iron unless the latter is in its highest state of oxidation. As air is essential to bring it into this condition, the necessity of tight seams in canned sweet potatoes is emphasized.

Charles L. Parsons,
Secretary

regard to the structure of atoms, and these are consistent with those previously proposed.

Postulate 1.—The electrons in atoms tend to surround the nucleus in successive layers containing 2, 8, 8, 18, 18 and 32 electrons respectively.

The word atom is used in the broader sense which includes charged atoms (ions). If the number of electrons in an atom is such that they can not all form into *complete layers* in accord with Postulate 1, the extra electrons remain in the outside layer as an *incomplete layer* which we may designate as the *sheath* of the atom. Every electrically neutral atom must contain a number of electrons equal to the atomic number of the nucleus. If the outside layer of such an atom is nearly complete, the tendency expressed by Postulate 1 may cause a few additional electrons to be taken up in order to complete the layer, thus forming a negatively charged atom or ion. In such a case we may say that the sheath has been completed.

In the following discussion it is important to keep in mind this distinction between sheath and outside layer. Every incomplete outside layer which occurs normally is a sheath, but a complete outside layer may or may not be a sheath. The following definition will make this clearer. *The sheath of any atom (or atomic ion) consists of all the electrons in the outside layer provided that this layer is incomplete when the atom is electrically neutral.* Thus atoms of the inert gases (neon, argon, etc.) and ions such as Na^{+}, Ca^{++}, etc., have *no sheaths* for the outside layers of these atoms consist of electrons which already form a complete layer in the neutral atom. The sodium *atom,* however, has an *incomplete sheath containing* one electron, while the fluorine atom has an incomplete sheath of 7 electrons. The fluorine *ion,* on the other hand, has a *complete sheath* of 8 electrons.

The inert gases are the only elements whose neutral atoms have no sheaths, or in other words have all their electrons arranged in complete layers in accordance with Postulate 1. In all other atoms, the tendency expressed by this postulate can only be satisfied by an interaction between atoms involving a rearrangement of the electrons. This is to be regarded as the fundamental cause of chemical action and it is by such interaction that chemical compounds are formed.

When as the result of such rearrangement of electrons, the sheath of an atom has become complete, we may speak of the atom as a *complete atom.* Similarly if the interaction between atoms leads to complete satisfaction of the tendency of Postulate 1, so that all the atoms become complete, we may say that a *complete compound* is formed. We shall see that there are some factors which may oppose the formation of complete atoms and counteract the tendency of Postulate 1. In such cases incomplete atoms and compounds may result.

According to Postulate 1, the first complete layer in any atom consists of two electrons close to the nucleus. Let us call this stable pair of electrons a *duplet* and let us broaden the definition of duplet to include any pair of electrons which is rendered stable by its proximity to one or more positive charges. We may now state the second postulate.

Postulate 2.—Two atoms may be coupled together by one or more duplets held in common by the completed sheaths of the atoms.

Let us now analyze the conditions that must be fulfilled if the interaction between atoms is to result in the formation of a complete compound.

A given group of neutral atoms may interact to complete their sheaths in two ways:

1. *By transfer of electrons.*
   a. Atoms having sheaths containing only a few electrons may give up these extra electrons to other atoms.
   b. Atoms having nearly complete sheaths may take up electrons from other atoms.
2. *By sharing duplets.*
   Atoms may share duplets with other atoms (Postulate 2) and thus complete their sheaths with fewer elec-

mains after the sheath is removed. Since the neon atom has no sheath the whole atom constitutes a kernel with zero charge. The kernel of the sodium atom is the sodium ion with single positive charge, while the kernel of the fluorine atom (or fluorine ion) consists of the nucleus and two electrons, the whole having 7 positive charges.

Since the sheath of any neutral atom consists of e electrons, the positive charge on the kernel is also e. In any complete atom there are s electrons in the sheath. When the atom does not share duplets with other atoms (covalence zero) then the total charge of the atom is $e - s$. If, however, any two atoms hold a duplet in common the total charge of the two atoms is decreased by two units. *If the two atoms are substantially alike in size and structure,* we may assume that this decrease in charge is to be divided equally between the two atoms. Thus if an atom in a compound has s electrons in its sheath and it has a covalence v_c then the effective charge of its sheath is $s - v_c$. The total charge of the atom may thus be taken as

$$e - (s - v_c) = v_e + v_c = v.$$

Thus v, the sum of the electrovalence and the covalence, for any atom in a compound, is equal to the *residual atomic charge.*

When two atoms which hold a duplet in common differ considerably in size, it is no longer obvious that the two electrons of the duplet should be divided equally between the two atoms in determining the residual charge. We may, however, arbitrarily so define the boundaries of the individual atoms in molecules that a duplet binding two atoms together is to be regarded as belonging equally to the two atoms. In this case we may consider v to be the residual atomic charge even when the atoms differ greatly in size.

It is evident from Coulomb's law that the separation of positive from negative charges requires in general the expenditure of work. The most stable forms of matter should be those in which the positive and negative charges are as near together as possible. However, we can not rely entirely upon Coulomb's law for this would indicate that the distance between unlike particles should decrease without limit. The exact distribution of charged particles in their most stable arrangements thus requires a knowledge of the repulsive forces whose existence we have already assumed. A further discussion of this point will be reserved for a future paper. At present we may attempt to express this relation by the following postulate.

Postulate 3.—The residual charge on each atom and on each group of atoms tends to a minimum.

By "residual charge" is meant the total charge of an atom or group of atoms regardless of sign. By "group of atoms" is meant any aggregate of atoms which are characterized by proximity to one another. It is felt by the writer that this postulate is a crude expression of a very important and fundamental law. When we understand the repulsive forces between charged particles better we shall be able to state the law in a more nearly quantitative form. The law is of very wide application. The uniformity of distribution of positive and negative ions in a salt solution is a familiar example of the working of this law. In any small finite element of volume the charges of the positive and negative ions tend to be very nearly equal or the residual charge tends to a minimum.

Postulate 3 expresses merely a strong *tendency* so that in general the charges of individual atoms are not necessarily zero. When the atomic charges depart from zero, however, they do so only as the result of a definite force or action which opposes the tendency of Postulate 3. We shall see that Postulates 1 and 3 are often in conflict and in such cases the tendency of Postulate 1 may prevail against that of Postulate 3.

We may now classify chemical compounds according to the types of valence exhibited by their atoms and will consider the application of Postulate 3 to each class of compound. There are 3 general subdivisions to consider: (1) Complete Compounds, (2) Incomplete Compounds, and (3) Exceptional Cases.

1. Complete Compounds.—All electrons are

the crystalline state and their molecular weights are unknown.

Molybdenum carbonyl, $Mo(CO)_6$,[5] is a very easily *volatile* crystalline compound. It is interesting to note that the *negative valence* of molybdenum ($s - e = 18 - 6$) is twelve, so that with a covalence of 12 for the molybdenum atom in this compound we again obtain a structure consistent with the valence theory discussed above.

2. Incomplete Compounds.—These are compounds in which some of the electrons are not arranged in complete layers or sheaths, so that the tendency of Postulate 1 is not completely satisfied. This can only occur as a result of a conflict between Postulate 1 and Coulomb's law or Postulate 3. We have seen that the tendency of Postulate 3 causes the residual charge (v) on each atom to be a minimum. The tendency of Postulate 1, however, is sufficiently strong to force the atoms to take up charges of 3, 4, or even under some conditions, 5 or 6 units, if this should be necessary in order to bring all the electrons into complete layers. Since there must be a limit to the strength of the tendency of Postulate 1 it is not surprising that residual atomic charges greater than 4 or 6 are very rare. Now the atoms of the elements near the middles of the long periods (of 18 and 32 elements), do not become complete even if they do acquire residual charges as great as 5 or 6 units, and it is therefore natural that the tendency of Postulate 3, which must become stronger as the charge increases, should prevent the formation of complete compounds of these elements. There are two types of incomplete compounds to consider.

a. Metallic Substances. Electronegative Atoms Absent.—By Coulomb's law, atoms having only small charges on their kernels, should not be able to take up enough electrons to complete sheaths of 8 or more electrons. Thus if we bring together a number of electropositive atoms there is no way in which the electrons in the incomplete sheaths can rearrange themselves to form complete sheaths. The "free" electrons which are thus compelled to remain in incomplete sheaths are responsible for the metallic properties shown by all electropositive elements in the solid or liquid state. It is clear, however, notwithstanding the fact that hydrogen may sometimes function as an electropositive element, that liquid or solid hydrogen should have none of these metallic properties according to this theory, for the sheath to be formed in this case contains only two electrons. The forces acting between the free electrons and the kernels of the atoms in metallic substances, are of the same order of magnitude as in salts, so that metals have about the same range of vapor pressures, hardness, compressibilities, etc., that are shown by salts.

In general, all atoms must be electropositive unless they can take up enough electrons to complete their sheaths and thus act as electronegative atoms. The tendency of Postulate 3 ordinarily prevents the occurrence of negative valences greater than about 4. In the two short periods eight electrons are needed to form a complete sheath so that the elements with kernel charges greater than about 3 can act as electronegative atoms and therefore do not normally show metallic properties. In the 2 long periods 18 electrons form the complete sheath so that about the first 14 of the elements in each of these periods can usually act only as electropositive elements and they thus have metallic properties, when in the elementary form. For similar reasons all the known elements of the rare earth period (the last two being unknown) have metallic properties.

b. Compounds Containing Electropositive and Electronegative Atoms.—As a result of Coulomb's law or Postulate 3, the positive valence of an element is usually limited to a value of 2 or 3 unless particularly strong forces are exerted to draw away electrons, and thus raise the positive valence a few units higher. Thus in the middle of the long periods the charges of the kernels are so great that all the electrons in the sheaths of the electropositive atoms can not be given up even when other atoms are present that can take up electrons. It thus happens that the long pe-

[5] Mond, Hirtz, Cowap, *J. Chem. Soc.*, 97, 798 (1910).

president of the French Republic, presided at the opening meeting, a gathering at which explorers and geographers from various parts of the world were present.

Dr. E. J. Russell, director of the Rothamsted Experimental Station, has been appointed a foreign corresponding member of the Reale Istituto Lombardo di Scienze e Lettere di Milano.

W. M. Smart, chief assistant at the Cambridge Observatory, has been appointed to the John Couch Adams Astronomership, recently founded in Cambridge University under a bequest from the late Mrs. Adams.

The board of regents of the University of Michigan has adopted congratulatory and laudatory resolutions in recognition of the services of Professor W. W. Beman, who has for fifty consecutive years been a member of the literary faculty and for thirty-four years head of the department of mathematics.

Professor Herbert E. Gregory, of Yale University, director of the Bishop Museum in Honolulu, has been awarded life membership in the National Geographic Society for his original contributions to geographic science.

Henry E. Allanson has been appointed assistant to the chief of the bureau of plant industry, Department of Agriculture. He is a graduate of Cornell University, and came to the bureau in 1911.

Professor Alexander M. Gray, director of the school of electrical engineering of Cornell University, has been granted leave of absence for the year 1921–22, because of ill health.

Dr. Walter Long Williams, professor of obstetrics and research in the diseases of breeding animals, has retired from the faculty of the New York State Veterinary College at Cornell University. Dr. Williams was a member of the original faculty of that college. For eighteen years he was professor of veterinary research and obstetrics and for the last seven years has devoted his time to the study of the diseases of breeding animals.

Dr. Edward Phelps Allis, Jr., has returned to his biological laboratory at Mentone, France, after some nine months in America.

An expedition on behalf of the State University of Iowa to the gulf coast of Florida was conducted by Professor H. R. Dill in the latter part of May. A collection of marine fishes was made which will be mounted for the museum.

The Hugo Müller lecture of the Chemical Society, entitled "The natural photosynthetic processes on land and in sea and air, and their relation to the origin and preservation of life upon the earth," will be delivered by Professor Benjamin Moore on June 16.

The geological library of 4,000 volumes and 15,000 geological specimens collected by the late Professor H. P. Cushing and his father-in-law, the late S. G. Williams, have been presented to Western Reserve University by Mrs. Cushing.

A monument in memory of the French chemist, Adolphe Wurtz, was unveiled at Strasbourg on July 5.

The death is announced at eighty-three years of age, of Professor Viktor von Lang, formerly professor of physics at Vienna.

The Mathematical Association of America and the American Mathematical Society will hold their summer meetings at Wellesley College, September 6–7 and 7–9, respectively. Two joint sessions will be devoted to a symposium on "Relativity." On the afternoon of the seventh, Professor Pierpont, of Yale University, will give a paper entitled "Some mathematical aspects of the theory of relativity," while on the forenoon of the eighth, Professor Lunn, of the University of Chicago, will speak on "The place of the Einstein theory in theoretical physics."

The regents of the University of California have granted $20,000 from the campus improvement fund to the Lick Observatory for the improvement of the grounds and buildings at Mount Hamilton.

The American Pharmaceutical Association

fer by two independent but equally powerful factors, neither of which shows dominance. F_1 will again be intermediate but of a single type and not more variable than either pure parent race. But F_2, by recombination of the two differential factors, will now consist of five graded types, two of which correspond with the parental types, while the remaining three are found in the intervening region at equally spaced intervals. If the several graded types are readily distinguishable one from another, they will be found to occur in the proportions 1 : 4 : 6 : 4 : 1. But if the types are so close together in appearance as not readily to be distinguishable, the distribution will resemble a probability curve.

Further, if three independent but equivalent factors are involved in a cross where dominance is wanting, the F_2 classes will number seven and their frequencies will be as 1 : 6 : 15 : 20 : 15 : 6 : 1.

Now, suppose that in these several hypothetical cases, the character under investigation is size, and that the amount of difference in size between the parents is in every case the same; let us say for convenience, 12 units (inches, pounds, or whatever the case may be). Then the several classes of individuals of which F_2 is composed will have the class magnitudes and frequencies shown in Table I.

For distributions, such as those shown in Table I., we can readily calculate standard deviations, which measure the variability of each array. See the last column of Table I. It will be observed that the standard deviation falls off rapidly as the number of factors involved increases. Inspection of the column headed "standard deviation" in Table I. will allow one to arrive at the law of decrease of the standard deviation with corresponding increase of factors. It is evident that as the number of factors is doubled, the standard deviation is halved under the radical sign. In other words, *to reduce the standard deviation by one half, the number of factors must be increased four fold.* With this point in mind one can extend as far as is desired the columns in Table I. headed "factors" and "standard deviation."

In Table I. the difference between the parents is assumed to be 12 units and the standard deviation is expressed in terms of those units. To give the table a general form, we might suppose the difference between the parents to be one unit. The standard deviation would then be only one twelfth as great. It is so given in Table II., wherein only the columns "factors" and "standard deviation" are entered from Table I.

TABLE II

Standard Deviation of F_2 Expressed in Per Cent. of the Difference between the Parent Races

Factors	Standard Deviation	Factors	Standard Deviation	Factors	Standard Deviation	Factors	Standard Deviation
1	35.35	13	9.75	44	5.32	144	2.94
2	25.00	14	9.50	48	5.10	160	2.79
3	20.41	15	9.12	52	4.87	176	2.66
4	17.67	16	8.81	56	4.75	192	2.55
5	15.81	17	8.53	60	4.56	208	2.43
6	14.43	18	8.33	64	4.40	224	2.37
7	13.33	20	7.90	68	4.26	240	2.28
8	12.50	24	7.21	72	4.16	256	2.20
9	11.78	28	6.66	80	3.95	272	2.13
10	11.18	32	6.25	90	3.60	288	2.08
11	10.64	36	5.89	112	3.33	320	1.97
12	10.20	40	5.59	128	3.12	384	1.80

In the foregoing discussion, it has been assumed that the parent races were completely homozygous and so deviod of *genetic* variability. If this were true of the parents, it would also be true of F_1. In that case whatever variability was exhibited by the parents or F_1 would be *non-genetic.* Under like environment F_2 would be expected to show a like amount of non-genetic variability. Hence in estimating the genetic variability of F_2 one would have to deduct from the total observed variability of F_2 an amount equal to the observed (non-genetic) variability of F_1.

In practise one would proceed as follows. First find the difference between the standard deviations of F_1 and F_2. Divide this by the difference between the parental means (the respective means of the two pure parent races). Multiply the quotient by 100. Now look in Table II. for the nearest corresponding number in the column "standard deviation." Op-

mutant in question. The metathorax of this mutant has apparently reverted to a condition approximating that occurring in the ancestors of the Diptera, in having a well-developed metanotum and other metathoracic sclerites, while the wings of this segment of the thorax, instead of being mere knobbed threads as in practically all Diptera, have become developed as comparatively broad wings, with a well-defined venation. I am hoping to be able to make a careful anatomical study of the thoracic structures of this mutant in the near future, and have offered this brief account merely as a preliminary note of an investigation which will be given more in detail in a later publication.

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SCIENTIFIC BOOKS

JONSTON'S NATURAL HISTORY OF FISHES

THROUGH the courtesy of Mr. Carl L. Hubbs of the University of Michigan, I have been able to examine a very rare book, seldom recorded in bibliography, the particular edition apparently not at all.

Its author is John Jonston, or as he writes it, Johannes Jonstonus, M.D., and its title page reads:

> *Johann Jonstoni* | Historiae Naturalis | de | *Piscibus* | et *Cetis* | Libri V | tabulis quadraginta septem | ab illo celeberrimo | *Mathia Meriano* | aeri incisis ornata | *ex scriptoribus* tam antiquis | quam recentioribus | maxima cura collecti | quos | ob *raritatem* denuo | imprimendos suscepit. *Franciscus Josephus* Eckerbrecht | *Bibliopola* Heilbrunnensis | *MDCCLXVII.*

Following this and bound with it is another volume, with the same title except for the words "de Exsanguibus Aquatilis Libri IV., tabulis viginti." This treats of invertebrates.

As this work bears the nominal date of 1767, subsequent to the "Systema Naturæ," it merits consideration in the interests of stable nomenclature.

[illegible] is throughout a compilation from earlier authors, the latest of which is Piso's edition of Marcgrave's "Historia Naturalis Brasiliæ," printed at Leyden in 1648. The sources of information are carefully and apparently accurately given in side-headings. There is some evidence of a system of classification. Book first, for example, treats of marine fishes. Title of those which are pelagic, Heading 1, of scaly pelagic fishes, and Article 1, "de Asellis" of various "cods." Most of the forms mentioned are indicated by Latin nouns, the Greek form often added, and occasionally a descriptive adjective gives a binomial form. I find, however, no trace of a binomial system of naming; the word species I have not noticed and the word genus, occasionally used, has no technical significance, meaning merely "kind."

The names used by Jonston could not enter scientific nomenclature even if the date of the publication were subsequent to 1758, a matter which may be open to doubt.

In Bosgoed's "Bibliotheca Ichthyologia et Piscatoria," 1874, page 9, is recorded a treatise by J. Jonston, with a similar but more extended title, said to be in five parts in two divisions ("dln.") with the dates 1650 to 1653, issued at Frankfort on the Main.

Apparently the volume before me is a reprint of the second "dealing" of this general work, as it bears a different date and the name of a different publisher. Bosgoed speaks of a new edition in Amsterdam in 1718, and an edition in Dutch in Amsterdam in 1660, translated from the Latin by M. Grausius. In advance proof sheets of the second edition of Dean's "Bibliography of Fishes," references are given to about a dozen editions in Latin or Dutch. One of these is dated 1677, but none 1767.

It may be questioned whether the date "MDCCLXVII" given on Libri IV. and V. alike is not a misprint for MDCLXVII. The appearance of the book and the absence of reference to any author later than 1648, would point in this direction. In any event, the names merit no consideration from systematists as, if really issued in 1767, it is merely an unmodified reprint of a pre-Linnæan,

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION H—ANTHROPOLOGY

At the Chicago meeting of Section H—Anthropology—the following officers were nominated:

Vice-president (1921), A. E. Jenks, Minneapolis, Minn.

Secretary (Jan., 1921–Dec., 1924), E. A. Hooton, Cambridge, Mass.

The following members of the Sectional Committee were elected: B. Laufer (Jan., 1921–Dec., 1924), Chicago, Ill.; F. C. Cole (Jan., 1921–Dec., 1922), Chicago, Ill.

The Sectional Committee is constituted as follows: A. E. Jenks, chairman, Minneapolis, Minn.; E. A. Hooton (Jan., 1921–Dec., 1924), Cambridge, Mass.; Aleš Hrdlička (Jan., 1920–Dec., 1923), Washington, D. C.; Berthold Laufer (Jan., 1921–Dec., 1924), Chicago, Ill.; R. J. Terry (Jan., 1920–Dec., 1921), St. Louis, Mo.; F. C. Cole (Jan., 1921–Dec., 1922), Chicago, Ill.; Clark Wissler (1921), from the American Anthropological Association, Washington, D. C.; J. Walter Fewkes (1921), from the American Anthropological Association, Washington, D. C.

The following papers were read and discussed:

The practical value of anthropology to our nation: A. E. Jenks, University of Minnesota.

The grouping of Piman languages upon a phonetic basis: J. A. Mason, Field Museum of Natural History.

A project for the study of race mixture in the United States: E. A. Hooton, Harvard University.

The peopling of Asia: A. Hrdlička, U. S. National Museum.

The influence of sex and stock upon the pubic bones: T. Wingate Todd, Western Reserve University.

Variations in the weight of new-born children with particular reference to racial differences; comparative growth of premature and normal children: E. E. Scammon, University of Minnesota.

A bird's-eye view of American languages north of Mexico: E. Sapir, Geological Survey, Canada.

The scaphoid type of scapula: W. W. Graves, St. Louis, Mo.

The native culture of the Czecho-Slovak people and its relation to other European cultures: K. Chotek, Ethnographical Museum, Prague.

The present state of anthropological research in the Philippines: F. C. Cole, Field Museum of Natural History.

The relative dating of Aztec and Pueblo Bonito ruins, by growth rings on the timbers: A. E. Douglass, University of Arizona.

Aztalan: S. A. Barrett, Milwaukee Public Museum.

Anthropology at the Pan-Pacific Congress: Clark Wissler, National Research Council.

The American plant migration: Berthold Laufer, Field Museum of Natural History.

The criteria for a general, ancient Algonkin culture: Alanson Skinner, Milwaukee Public Museum.

The Hidatsa Indian: Care and training of the dog and horse: Gilbert L. Wilson, Macalester College.

The preservation of Indian remains in Wisconsin: Chas. E. Brown, Sec., Wisconsin Archeological Society.

The following papers were read by title:

Geographical influences upon human culture with special reference to the Great Plains: Melvin R. Gilmore, State Historical Society of North Dakota.

The technique of paleopathology as applied to human remains: Roy L. Moodie, University of Illinois, College of Medicine.

Aboriginal population in California: A. L. Kroeber, University of California.

Some vital aspects of the American Indian: Frederick L. Hoffman, Prudential Life Insurance Company.

Waning stone age industries among the Wisconsin Indians: Alanson Skinner, Milwaukee Public Museum.

Current illogical extravagant estimates concerning the antiquity of man: G. Frederic Wright, Oberlin College.

The afternoon session of December 29 was devoted to a conference on State Archeological Surveys.

On the afternoon of December 30, the section visited the Field Museum of Natural History to inspect the anthropological exhibits and afterwards visited the Newberry Library for an examination of the Ayer collection of Americana.

E. A. Hooton,
Secretary, Section H

is laborious, excessively so where, as in the present case, many decimal places are required, it is possible to make a closely approximate integration of small segments of the function:

$$y dx = e^{-x^2} dx$$

such as

$$\int_{-z}^{z} e^{-(a+z)^2} dz,$$

where a is any abscissa and z is small.

Expanding the exponent, this becomes:

$$\int_{-z}^{z} e^{-a^2} \cdot e^{-2az} \cdot e^{-z^2},$$

which by putting

$$e^{-z^2} = 1 - z^2,$$

becomes

$$e^{-a^2} \int_{-z}^{z} (1 - z^2) e^{-2az}$$

$$= e^{-a^2} \left[e^{-2az} \left(\frac{z^2 - 1}{2a} + \frac{z}{2a^2} + \frac{1}{4a^3} \right) - e^{2az} \left(\frac{z^2 - 1}{2a} - \frac{z}{2a^2} + \frac{1}{4a^3} \right) \right].$$

Reducing and substituting for z the value 1/10 gives:

$$\int_{-1}^{1/10} e^{-(a+z)^2} = \frac{e^{-a^2}}{4a^3} \left[(e^{a/5} + e^{-a/5}) a/5 + (e^{a/5} - e^{-a/5})(1.98a^2 - 1) \right].$$

Thus, by assigning values to a, progressing by 0.2, the areas of the segments of the integral for the abscissal intervals $a \pm 1/10$ could be closely approximated and summated, the values in the table being finally:

$$\log \left(2 \int_x^{\infty} \frac{h}{\sqrt{\pi}} e^{-h^2x^2} dx \right):$$

or log $(1 - P)$, according to the usual symbology. It was found that it was only necessary in the extreme value given ($hx = 7.0$) to carry the computation a few steps farther, in order that the sum of the subsequent segments to infinity should be a vanishing quantity with respect to the degree of precision decided upon. The table is not to be looked upon as more than supplementary to the tables in general use, and upon examination, it will appear that the error introduced by assuming that $e^{-z^2} = 1 - z^2$ is negligible since, for $z = 1/10$ this error at its maximum is only as 0.99 — 0.99005 to 0.99, or 5 parts in 99,000 *with respect to* $1 - P$, and on the whole, even less than this; and it is the values of $1 - P$, smaller than those obtainable from the usual tables, in which we are here interested. The values of this table check with those in the usual tables, as far as the latter go, and also (in the extreme cases, especially where $hx = 5.0$, 5.5 and 6.0) with the values given in the original work of Burgess.[3]

EXPLANATION OF TABLE

Common logarithms of the values of the integral:

$$2 \frac{h}{\sqrt{\pi}} \int_x^{\infty} e^{-h^2x^2} dx \; (= 1 - P)$$

for various values of hx.

$$hx = \frac{0.4769x}{E} = \frac{0.7071x}{\sigma},$$

where E is the probable error and σ the quadratic mean error.

Interpolations will be fairly accurate to the fourth place if proper account be taken of the second difference.

hx	log (1 — P)	hx	log (1 — P)
0.0	0.0000	3.5	3.8710–10
0.1	9.9482–10	3.6	3.5513
0.2	9.8906	3.7	3.2231
0.3	9.8270	3.8	2.8865
0.4	9.7571	3.9	2.5415
0.5	9.6808	4.0	2.1880
0.6	9.5978	4.1	1.8261
0.7	9.5081	4.2	1.4557
0.8	9.4115	4.3	1.0768
0.9	9.3077	4.4	0.6895
1.0	9.1967	4.5	0.2936–10
1.1	9.0784	4.6	9.8893–20
1.2	8.9527	4.7	9.4764
1.3	8.8195	4.8	9.0551
1.4	8.6787	4.9	8.6252
1.5	8.5301	5.0	8.1868
1.6	8.3739	5.1	7.7399

[3] Burgess, *Trans. Roy. Soc. Edinb.*, XXXIX., p. 257 ff. "On the Definite Integral $(2/\pi) \int_0^t e^{-t^2} dt$ with Extended Tables of Values."

thei[illegible] on[illegible] pr[illegible] ti[illegible] t[illegible] [illegible] Time [illegible] I [illegible] ques- [illegible] advanced in [illegible] or not [illegible] energies of man [illegible] of human [illegible] and the [illegible] mentioned [illegible] our planet [illegible] with a civiliz- [illegible] are powerless to [illegible] or even to con- [illegible] And yet that law is [illegible] time-binding energies [illegible] been the trouble? What [illegible] has been is pretty plain. [illegible] what we human beings do [illegible] merely upon what we are but, [illegible] greater measure, upon what we [illegible] From time immemorial the [illegible] energies of our humankind have [illegible] by the false conception that [illegible] species of animal and hampered by [illegible] conception that man is a miracul- [illegible] of natural and supernatural. [illegible] the long period of our race's [illegible] from which we have not yet [illegible] misconceptions have lain [illegible] the course of civilization. All that [illegible] in present civilization has been [illegible] in spite of them. The goods, the [illegible] achievements, of which they have [illegible] the world, we can not now know [illegible] subtle ramifications of their *positive* [illegible] we can trace in a thousand ways. And [illegible] duty and mine to trace them. Who- [illegible] the duty will be appalled. I [illegible] dwell upon the matter here. Suffice [illegible] that, if we humans do not in fact [illegible] a perfectly natural class of life, [illegible] never has been and never can be a [illegible] ethics having the understandability, [illegible] sanction and the authority of natural law; [illegible] constitute such a class of life but [illegible] to think we do *not*, the result will [illegible] the same our ethics will continue to carry the confusion and darkness produced by the presence in it of mythological elements. If, on the other hand, human beings continue to regard man as a species of animal, then the social life of the world in all its aspects will continue to reflect the misconception; especially our ethics, which subtly pervades, colors and fashions all of the social sciences, will continue to be—what it always has been in large measure—a zoological ethics, animal ethics, the ethics of tooth and claw, space-binding ethics, the ethics of strife, violence, combat and war.

So it has been, but it will not continue so to be if we have the wisdom to learn the fundamental lesson of our recent experience. What is that lesson? It is this: the World War was an unforeseen, sudden, cataclysmic demonstration of human ignorance of human nature—a demonstration, pitiless as fate or famine, that human beings have never rightly conceived Man to be what Man is—not a mixture of natural and supernatural nor a species of animal, but the natural agency for those time-binding energies in the world whose peculiar function it is to produce civilization and to do so in conformity with its marvelous law of an increasing function of time.

That conception will be found, I believe, to initiate a new epoch—the epoch of humanity's manhood. The concept is easy to grasp—all, and especially the young, can understand it. Once it is understood, human life will accord with human nature, the time-binding energies will be freed from the old bondage, and civilization will at length advance in accord with its natural Law as the great forward-leaping exponential function of Time. There will be great changes and many transfigurations. Education—education in home, school and church—will have for its supreme function to teach the children of man what man is and what they are. Ethics will abandon the space-binding standards of animals and will become *human* ethics based upon the natural laws of the time-binding energies of man. Freedom will be freedom to live in accord with those laws and righteousness will

[illegible]

hood content had been increased by four-fold, due in a large measure to the agar.

It is not to be supposed that the safe removal of the object was due wholly to the agar, though this probably at least hastened its removal. As the experiment was wholly satisfactory however it would lead to the recommendation of the use of agar for this purpose. In the case of the removal of objects more dangerous, or more difficult of removal, it might prove a decisive factor.

[illegible] S. [illegible]

Department of Chemistry,
University of Southern California

AN INCONSISTENCY IN TAXONOMY

In the classification of animals we are often very inconsistent in the use and evaluation of characters as we apply them to different groups. This is more apparent between widely separated groups than closely related ones. Thus in the subgroups in one class of the vertebrates, osteological or other anatomical characters may be largely used, while in another class such internal characters may be entirely subordinated to external ones. [illegible], to be sure, certain characters have [illegible] same value in one class that they have [illegible], but the main reason for the inconsistency lies in the less skilful or less thorough [illegible] of one group as compared with [illegible] of one group [illegible]. The result is, classification became [illegible] long before the groups, especially [illegible], were well formulated. [illegible] larger ones, as well as genera there are [illegible] so extreme as the following.

There are two genera of sharks, Mustelus and [illegible] that are strikingly similar in all [illegible] characters. We refer them to different genera because they differ in regard to a [illegible] the yolk sac in the young. In Mustelus the yolk sac is modified to function as a placenta by which the young forms a connection with the walls of the mullerian [illegible] of the mother. This so-called placenta [illegible], or, more correctly speaking, is absent in [illegible] unmodified.

On the other hand we place two mackerel [illegible] in the genus Scomber even though

in predicting the record of the second year. has already the prediction of first year egg our immediate purpose is the

[2] Harris, Blakeslee and Kirkpatrick, *Genetics*, 3: 42–44, 49–56, 1918.

consideration of the second year production of birds which did and of those which did not lay months of the first year, it to give the mean first these birds as well. For comparison the results deduced from the data

MEAN ANNUAL PRODUCTION FOR FIRST AND SECOND YEAR FOR BIRDS WHICH DID AND WHICH DID NOT LAY DURING

that the poles were not fixed but
in a circle and he fixed the diamet
circle and the period of revoluti
curately that only the most mod
ments can detect the small amou
was in error.

Perhaps the most noteworthy of
scientists was Hipparchus of Rh
146 B.C.). He discovered the prec
equinoxes due to a slight progre
in the equinoxial points where
equator and the ecliptic meet,
with almost modern exactness.
which the plane of the earth's
would shift from maximum to
determined the length of the
minutes. He established the T
corn and Cancer within twe
their present location and
this he invented the science
Surely many a modern w
rested on his laurels after
theless he was not content
prepared a star catalogue
stars, his list of constellati
of the one used at pres
wonder what such a gen
complished had he had
and libraries.

The few old manuscr
tell a wonderous story of
and early Greece and
how many more of the
were known to the anci
that human evolution
Golden Age of Greec
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with their captive rac
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dawning—has, in some
rved. Science is sweep-
remendous strides, and I
young candidate for the
100 years hence will be
through the literature and
graphic history of the problem
as his dissertation.

vision of the future. How
utilize to its best advantage
of these specialists fifty or
ears hence? How are the great
the world to be solved by men
ny isolated trees in the great
ure? Probably the answer is
A problem will be attacked not
ker but by ten, twenty or one
workers, who will pool their knowl-
individuality, their selfishness and
ll work together for the glory of
nd the good of mankind. Dr.
the director of the new Thompson
for Plant Research, recently said
at he believed the day was not far
when five or ten men would be per-
to present a single dissertation for
tor's degree, a masterpiece of research
out in cooperation by the group, and
which each had put the best of his effort
manipulative skill. He has already so
convinced the graduate school of the Uni-
of Chicago that in one or two instances

of corn is here reported for the first time ur knowledge in this country. This us was first described by Butler and Kahn) as a parasite of sugar cane in India. etailed report on these studies will ap- in the February issue of the Journal Agricultural Research.

T. F. MANNS,
J. F. ADAMS
AGRICULTURAL EXPERIMENT STATION,
UNIVERSITY OF DELAWARE,
May 10, 1921

ERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

e sixty-second general meeting of the Ameri- hemical Society was called to order at Colum- University, New York City, on Wednesday ing, September 7, 1921, with President Edgar mith presiding. The welcoming address was red by Dr. John E. Teeple, chairman of the York Section, to which Dr. Smith responded half of the Society.

address of Hon. Francis P. Garvan on mistry and the State" roused the audience high pitch of feeling regarding the present al situation which chemistry in America is g. The address of Sir William J. Pope on mical Warfare" and of Professor R. F. Rut- n "Organization of Industrial Research in la" were also received with enthusiasm. The sses in full will appear in the October issue Journal of Industrial and Engineering Chem-

Smith read the following telegram of greet- rom President Harding, which had been orig- received as the visiting guests crossed the r into the United States at Niagara Falls on ay, September 5, 1921:

s a pleasure to extend greetings to the gath- of American, Canadian and British Societies enting the chemical sciences and industries g on American soil. Probably none of the alistic sciences holds promise of so great con- ns to human welfare in the coming genera- that which your organization represents. lopments of applied chemistry involve both ity of vastly increased horrors in human d alternately inestimable benefits to a vilization. Let us hope that a science so h either good or vicious possibilities d, through the wisdom of the nations, and advancement of mankind.

WARREN G. HARDING

n was received with enthusiasm and the Society requested President Smith to express its appreciation in a suitable reply.

In accordance with the nominations of the council, Sir William Pope and M. Paul Kestner were elected honorary members of the society. Sir William responded in a delightful vein and expressed the extreme regret of M. Kestner at his inability to attend these meetings. Dr. Robert F. Ruttan, president-elect of the Society of Chemical Industry, and Dr. Ernst Cohen of the University of Utrecht were presented to the audience and heartily received.

The Committee appointed by the Council consisting of Messrs. H. T. Clarke, F. R. Eldred, and Chas. H. Herty submitted the following resolution, which was unanimously adopted:

Believing in the incalculable peace-time benefits which accrue from the development of the science of organic chemistry and its application in medicine, agriculture and the industries connected with foods, fuels, textiles and dyes.

Realizing the great rôle that organic chemistry has played in the development of chemical warfare, we call the attention of this nation to the grave crisis which threatens our organic chemical industry.

In spite of the tremendous strides made during the past five years in the United States, this important industry is still centered in Germany. Other nations have already sought to safeguard its future in their countries by appropriate legislation. America stands hesitant. Progress has been checked and indeed the very industry is threatened with destruction. Two agencies will be determinative in averting this disaster, the approaching International Conference on Disarmament and the Congress of the United States.

Resolved, therefore,

First, that we urge upon the American delegates to the Disarmament Conference most serious consideration of the broad question of chemical disarmament as affected by the development and maintenance of the chemical industries in the several nations.

Second, that we urge upon Congress the necessity of including in the permanent tariff bill a selective embargo for a limited period against importation of synthetic organic chemicals, and we express the confident hope that in view of the important bearing of such action on economical development and on national defense, our representatives regardless of political affiliations will support this legislation.

The fiftieth anniversary of Sir James and Lady Dewar's marriage having been recently celebrated, on August 8, it was moved that a congratulatory message be transmitted from the American Chemical Society.

On Tuesday evening a complimentary smoker, with nearly one thousand members present, was held at the Waldorf-Astoria, and an interesting program

mixed and poured into the sterile culture dish containing the remaining part of the kernel. (These methods were used extensively by the senior writer in his studies on fungi internal of flax, 1901–1904, and wheat, 1909.) In this manner a greater distribution of the mycelium or spores is possible and allows for accurate interpretation in instances where more than one fungus is being carried.

In most of the cultural plate work a dextrose peptone agar of the following composition was used:—tap water 1000 c.c., dextrose 10 grams, peptone 1 gram, agar 15 grams. Twenty cubic centimeters of medium were used in all cultural plates in which ten kernels of corn were placed for germination.

A careful study of the anatomy of seed which showed heavy infection after a sterilizing treatment, readily indicated how these parasitic fungi were escaping the disinfectant. In most cases where the internal

pathogenes were not inhibiting ger
the fungi had gained entrance o
cavity under the "cap"; or had
but short distances under the peri
was true of each of the fungi *Cep*
sacchari, Gibberella saubinetii, F
niliforme and *Diplodia zeae.* W
of these pathogenes became esta
tissue comprizing the embryo t
either destroyed or greatly i
servations thus far made indi
of cultural and germinator
order of importance of inhibi
Diplodia zeae stands first,
by *Gibberella saubinetii,*
forme and *Cephalosporium*

The samples submitted f
states other than Delawa
sarily representative. T
least the general occurre

The establishment of

DISTRIBUTION AND PREVALENCE OF PARASITIC FUNGI INTERNAL OF

[1] All data repor

...e. ...wo ...pe, ...pear ...of the ...er the ...100 per ...visibility ...and at a ...relation, ...r diameter ...s light and ...rs when the ...ne the star's ...r of the star ...lax is known. ...described to- ...g it. It consists ...t long, carrying ...°, the two inner ...vnwards, the two ...ards. It is placed ...observations made ...has an equivalent ...auxiliary optical de- ...wedge of glass and a ...ables the observer to ...ght and obtain the de- ...al pencils passing over ...scope, form a compari- ...ringes superposed; both ...rison images are viewed ...epiece. When the seeing ...difficult to be certain that the fringes ...lly vanished; a weakening of the zero ...however, at the same time furnishes the ...with a check in the matter.

...ember 13, 1920, the interferometer fringes ...d for α Orionis when the distance between ...rrors was about ten feet. The seeing was ...and the instrument adjustments were verified ...eck stars both before and after the observa-...n. Assuming a wave-length of 5.75×10^{-5} cm. the ...proximate angular diameter is $0''.047$. Using a ...lue of $0''.020$ for the parallax, the linear diam-...ter is roughly 218,000,000 miles.

Definite decrease in visibility of the fringes has been observed by the writer with the 20 foot interferometer, for α Tauri, α Bootis, α Scorpii and β Geminorum. The diameter of β Geminorum is smaller than can be measured with this interferometer. Additional observations will be necessary to definitely determine the diameter of the others. The work will be continued until all the brighter stars have been examined.

Atomic theory and ideal numbers: LEONARD EUGENE DICKSON. On the basis of close analogies with the molecular and atomic theories, it is possible to give a clear insight into the nature of ideal numbers, which play such an important rôle in the mathematical world to-day. This special importance is due to the fact that only after the introduction of ideal numbers do the laws of divisibility, valid in arithmetic, hold also for algebraic numbers. Without ideal numbers the situation in regard to algebraic numbers is most chaotic. The restoration of order out of chaos by the invention of ideal numbers is one of the chief mathematical triumphs of our century.

A general catalog of stellar distances: FRANK SCHLESINGER. This paper deals with a review of the various methods for determining stellar distances and describes the methods that have been employed to mold the observations into a homogeneous whole.

Intermittent vision at low intensities: HERBERT E. IVES. An experimental study of the phenomena of flicker at low intensities where twilight or rod vision prevails. Blue light was used, reduced in intensity until all sensation of color disappeared. Under these conditions the speed of alternation of light and dark at which flicker disappears, becomes independent of changes of intensity, unlike its behavior at high intensities where it increases or decreases as the intensity is raised or lowered. The

DR. K. G. MATHESON, president of the Georgia School of Technology since 1906, has resigned to become president of Drexel Institute. Dr. Matheson will go to Drexel next spring, probably April 1. Until then the institute will continue to be directed by the administrative board, which took charge upon the recent retirement of Dr. Hollis Godfrey.

DR. FRANKLIN STEWART HARRIS was installed as president of Brigham Young University at Provo, Utah, on October 17. Dr. Harris, who was formerly director of the Utah Agricultural Experiment Station, succeeds President George H. Brimhall, who becomes president emeritus.

DR. FRANK PIERREPOINT GRAVES, formerly head of the school of education of the University of Pennsylvania, who succeeds Dr. John H. Finley as commissioner of education of New York State, and president of the University of the State of New York, was inducted into office on October 20.

DR. HARRY W. CRANE, assistant professor of psychology at Ohio State University, has been called to an associate professorship in psychology at the University of North Carolina. He will also act as psychiatrist to the State Board of Public Welfare.

DISCUSSION AND CORRESPONDENCE

A BIRD'S-EYE VIEW OF AMERICAN LANGUAGES NORTH OF MEXICO

IT is clear that the orthodox "Powell" classification of American languages, useful as it has proved itself to be, needs to be superseded by a more inclusive grouping based on an intensive comparative study of morphological features and lexical elements. The recognition of 50 to 60 genetically independent "stocks" north of Mexico alone is tantamount to a historical absurdity. Many serious difficulties lie in the way of the task of reduction, among which may be mentioned the fact that our knowledge of many, indeed of most, American languages is still sadly fragmentary; that frequent allowance must be made for linguistic borrowing and for the convergent development of features that are only descriptively, not historically, comparable; and that our persistently, and rather fruitlessly, "psychological" approach to the study of American languages has tended to dull our sense of underlying drift, of basic linguistic forms, and of lines of historical reconstruction. Any genetic reconstruction that can be offered now is necessarily but an exceedingly rough approximation to the truth at best. It is certain to require the most serious revision as our study progresses. Nevertheless I consider a tentative scheme as possessed of real value. It should act as a stimulus to more profound investigations and as a first attempt to shape the historical problem. On the basis of both morphological and, in part, lexical evidence, the following six great groups, presumably genetic, may be recognized:

- I. Eskimo-Aleut
- II. Algonkin-Wakashan
  - Algonkin-Wiyot-Yurok
  - Kootenay
  - Wakashan-Salish
- III. Na-dene (Haida; Tlingit-Athabaskan)
- IV. Penutian
  - Californian Penutian
  - Oregon Penutian
  - Tsimshian
- V. Hokan-Siouan
  - Yuki
  - Hokan
  - Coahuiltecan group
  - Keres
  - Tunica group
  - Siouan-Yuchi-Muskogian
  - Iroquois-Caddoan
- VI. Aztec-Tanoan
  - Uto-Aztekan
  - Tanoan-Kiowa

This leaves the Waiilatpuan-Lutuami-Sahaptin group, Zuñi, and Beothuk as yet unplaced. The lines of cleavage seem greatest between IV. and V., and between III., on the one hand, and I. and II., on the other. Group V is probably the nearest to the generalized "typical American" type that is visualized by linguistic students at large.

E. SAPIR

CANADIAN GEOLOGICAL SURVEY,
OTTAWA

under the highest magnification of the microscope, (*d*) maintenance of the needle tip in one focal plane while it is being moved back and forth in any of the three directions. The basic principle of the instrument consists of rigid bars which are screwed apart against springs. The movements imparted are in arcs of a circle having a radius of from three to four inches. The arcs produced by the two lateral movements lie in one horizontal plane so that the needle tip does not drop out of focus during these movements. The curvature of the arc is unnoticeable as the extreme range of movements of the fine adjustments is only 3 mm. In the microscopic field no movement over one millimeter is ever required.

A full description of this instrument with photographs and diagrams is being published in the *Anatomical Record* and, possibly, in the *Journal of Bacteriology*. The principle on which the instrument depends is in the process of being patented.

The principle is demonstrated on considering the mechanism for the movements in one plane only (Fig. 1). This consists of three

bars of rigid metal connected at their ends to form a Z-like figure by resilient metal acting as a spring hinge.

By the action of certain screws the bars can be forced apart; on reversing the screws the bars return to their original position owing to the spring action at the ends of the bars. By these means arc movements may be imparted to the tip of a needle when placed in the proper position, and these movements are fine and steady enough to be under perfect control when viewed under the highest powers of the microscope.

The needle or any instrument the tip of which is to be manipulated is held in a carrier fastened to the free end of a bar *A* at *X*. The needle is made to extend so that its tip is at the apex of an imaginary triangle at *D*.

In order to obtain two movements at right angles to one another in the horizontal plane the tip of the needle must be at the apex *D* of a right-angled isosceles triangle, the base of which is a straight line joining the centers *E* and *F* of the springs holding the three bars, *A*, *B* and *C*, together. The shank of screw *G* passes through a large hole in bar *C* and is screw-threaded in bar *B*. Turning screw *G* spreads bars *B* and *A* apart thus imparting an arc movement to the needle tip at *D*. The other screw *H* is screw-threaded in bar *C*. Turning it spreads apart bars *C* and *B* and imparts an arc movement to the needle tip at *D* at right angles to that procured by turning screw *G*.

The movement in the vertical plane at right angles to the afore-mentioned movements is procured by screw *I* (Fig. 2), which

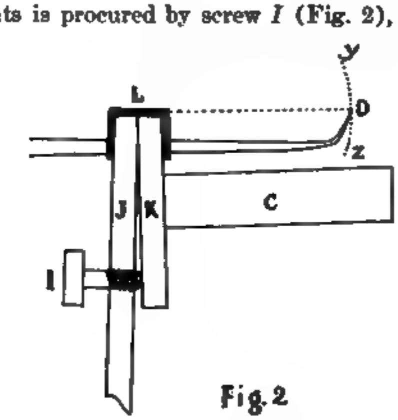

Fig. 2

is screw-threaded in a rigid vertical bar *J*

cares to explore unless particular business calls him.

We are now awaiting the report of the recent Government Commission, which visited Oxford and Cambridge during the last year. As a result of the war, or perhaps we should say of a necessary process hastened by the war, the ancient universities need government support. With support must go responsibility of a new kind, and possibly some sort of unification of the system. Is it possible that definite standards of equipment and teaching will eventually be required, enforced through some process of inspection? These are weighty matters for us here in America, for in many places we stand at the parting of the ways. The old freedom is difficult to maintain in the presence of a population requiring to be educated *en masse*. It matters too much if things are badly or wrongly done. At all hazards, we must maintain our intellectual integrity, but we necessarily sacrifice something of our independence. Does that mean that the best minds will gradually be robbed of their originality, grown prematurely inelastic and old? England, the home of the independent worker, has produced more original thinkers than America, whether we consider the sciences or the arts.

There is another and opposite side to the picture. The strong individuality of the leading English scientific men has had a profound influence on their colleagues, and this has been accentuated by the smallness of the country and consequent ease of communication. Professor Alfred Newton, whose teaching in certain of its aspects seemed so amazingly inadequate, was a very center of light and learning for an ardent group of ornithologists, through whom his influence radiates to this day. His "Dictionary of Birds" has no real competitor, and is one of the indispensable books to students of the subject. Throughout the Biography, here and there, we find a note of half regret that the Professor was so set in his ways, so peculiar, so amazingly conservative. Yet perhaps had he not developed freely in his own manner, his power would not have been so great. His old friend Dr. Guillemard thus sums up his impressions:

Such strength of individuality I can not recall in any other person I have known. It can safely be said that, having carefully envisaged his question and decided it, no human power could make him alter his mind. Yet one almost hesitates to say it, lest a wrong impression should be conveyed, for he was one of the most lovable of men, and inspired an unusual degree of personal affection in the many young men who frequented his rooms. The influence he exercised upon them was remarkable, not only upon the ornithologists, but upon men like Adam Sedgwick, Bateson, Frank Darwin, Lydekker, and a host of others in different fields. It would, I think, be correct to describe him as the founder of the modern Cambridge scientific school, developing the good seed sown by Henslow, who was to a former generation, I imagine, very much what Newton was to mine.

The statement about the modern scientific school applies of course only to the biological, or more specifically zoological, field. Even in the field of zoology Newton's knowledge was quite limited, but it was extraordinarily exact. His interest in birds was so wide that it led him into various fields, as for instance that of philology. Thus he combined what might be considered narrowness with a remarkable breadth of view, which undoubtedly added greatly to his beneficial influence on his students.

Sir Arthur Shipley, who was a student under Newton, gives a lively account of his lectures:

Newton's lectures were desperately dry and very formal. The Professor sat before a reading desk and read every word of the discourse from a written manuscript, written in his minute hand with a broad quill, so that all the letters looked the same, like the Burmese script. At long intervals there was drawn the outline of a tumbler. Whenever the Professor came to these outlines he religiously took a sip of water. Whether it was the time of day [1 p. m.] or whether it was that we students were all absorbed in comparative embryology and in morphology, the attendance was always small. I went during my second and third year, and at times was the sole auditor. Not that that made the least difference to the Professor. He steadily and relentlessly read on—"the majority of you now present know," "most of my audience are well aware," and similar phrases left me in considerable doubt